Using Spatial Decision Support Systems in Expert Workshops

Thomas C. Meredith

Department of Geography, McGill University, 805 Sherbrooke W, Montreal, PQ, Canada H3A 2K6

The Context

A McGill University team, working with environmental community groups, is conducting research on what sort of decision-making procedures lead to fairer, more efficient and more effective environmental choices. We believe there are two very promising, closely linked, avenues of research. One is to learn to make better use of existing information resources (both scientific and traditional). The other is to find ways to increase the potential for local environmental stewardship by making local participation in environmental decision-making (EDM) more effective. This brings "people most familiar with" and affected by local environmental problems into decision-making.

A central element in the work of the McGill University Project on Community Based Environmental Decision Support (CBED) is the "marginalization/empowerment" debate (Craig et al. In press) about information technology: does new technology assist in making public participation more effective or does it merely create a barrier that shelters technocrats and causes non-specialists to be excluded from decision-making processes?

One tool developed by CBED to explore these questions is Consensus Mapper. This a Geographic Information System (GIS) that allows collaborative exploration of spatial data, discussion of decision priorities, and mapping of environmental values or concerns. The Consensus Mapper is used in a *Round Table* meeting. The meetings permit stakeholders to participate in an open discussion about spatial understandings or priorities, but also to have independent means of expressing their own views. This allows groups with shared interests to clarify their common understandings and groups with divergent interests to clarify points of disagreement and perhaps work toward compromise. Round tables are about person-to-person communication of ideas; networked computers with an interactive GIS are intended to support this communication, but only as and when it is appropriate to facilitate inclusive communication and clarity in spatial decisions. This requires that the GIS be transparent to the users, not an obstacle or a force that dominates proceedings. This, in turn, requires strong technical support and open and adaptive facilitation.

This paper describes the use of this system in an expert workshop on defining North American priorities for biodiversity conservation. The workshop was sponsored by the Commission for Environmental Conservation (CEC), which is a creation of the North American Free Trade Agreement, and is intended to oversee continental scale environmental protection issues. Canada, the US and Mexico represent "frontline" questions in the global environment/sustainable development dialogue, and biodiversity protection is, amongst all environmental issues, perhaps the most irreversible, and the one with the strongest social dimension. For these reasons, researchers at CBED were anxious to engage with the CEC to explore questions of information management in North American biodiversity conservation decision making. A strong and clear consensus would support policy development and priority setting at the CEC. The CEC's interest was therefore in achieving a specific end "product" (a consensus statement on priority area) within a two day workshop, CBED's interest was in exploring the methodology in a time-constrained, "product-driven" setting.

The Program of Action

The proposal put forward by the CEC (discussed in Meredith 2000) was to bring experts in various fields of biodiversity conservation from the three different countries of NAFTA together for a two day consultation. While this is not "community-based" in the sense that CBED conventionally adopts, the CEC opportunity provided a unique opportunity for experimenting with methodology: the stakeholder group was clearly defined (academics, the non-governmental community and government representatives), the array of interests was diverse, the specific objectives were precisely stated and understood by all, the time frame was clearly bounded and, since all of the participants were professionals, we did not have to be as cautious about reticence as we would have been dealing with lay participants in a community-based EDM situation.

Three questions were identified that structured the workshop and allowed both objectives to be met:

1) From your experience, outline the top 10 *regions of high ecological priority* in North America (comparable to level 2 Ecoregion in scale).

2) From your experience, outline the top 10 *regions of high actual & potential threat to biodiversity* in North America (comparable to level 2 Ecoregion in scale).
3) From your experience, outline the top 10 *regions that offer actual & potential opportunities for biodiversity conservation* in North America (comparable to level 2 Ecoregion in scale).

The intent was not to provide new data to workshop participants that would inform them about how to identify or select regions. Rather we were attempting to solicit, sort and record local or traditional knowledge and value. The procedure was intended to:

1) allow experts with prior opinions to interact with one another
2) solicit a range of opinions and perhaps reach consensus on criteria to be used making priority designations
3) solicit a range of opinions and perhaps reach consensus on priority regions
4) derive both textual and spatial information supporting these opinions
5) verify the effectiveness of the decision support mechanism used.

Six laptop Pentium III computers were used, each with at least 32MB RAM, and each linked in a local network to a server. The speed of the computers was considered to be important so that processing time would not become a frustration if large or complex data bases were used. Each of the computers had an external mouse to facilitate drawing and a 17" monitor to improve visibility and allow groups to work together. The server was connected to a data projector capable of showing an image 1.5 X 2 m (approx.) that could be viewed by everyone in the room. In addition, each work station had a stand-alone word processing computer with Word and WordPad. These computers had been pre-loaded with forms that were available to structure group responses to specific events in the meeting. The forms were intended to simplify information entry and users understood that their use was not required.

The laptops were each loaded with a simple GIS, called Consensus Mapper, that was engineered by George Dias using ESRI Map Objects. The GIS was designed for non-GIS users and, consequently, had a simple yet robust design that allowed zooming on and panning over a base map, display of various map layers, the drawing and editing of polygons, the calculation of polygon areas, and the submission of finished maps, as Shape files, to the server.

The server ran ArcView III. The operator would receive the Shape files from the six workstations and overlay them to produce a map that reflected the degree of overlap of polygons. Results were scored with integer values indicating the number of overlapping polygons (hence, ranging from 0 to 6).

Participants were shown slides that repeated the questions (shown above) and added:

> *The answers should reflect your global knowledge of biodiversity, including, but not limited to, your own field of expertise. They should be reflected in mapped units "at the scale of level 2 ecoregions"(polygons should not be bigger than 500,000 km).*
>
> *The process: Clear and sound ideas are the ends, group discussion is the means and maps and computers are the aids. The process should balance free and open discussion of ideas with the need to capture and record some of those ideas.*

The entire group was divided into groups of three or four people (by theme/area of expertise, country or a combination of both, depending on the question being asked). These subgroups worked together, either in a break-out room or in the main conference room, to respond to each of the questions.

Each of these questions was discussed in plenary first so that the meaning and intention of the questions, and distinctions between the questions, were clear. For each question, groups were asked first to discuss the criteria that they would use to establish each of these maps and then to select — by tracing on a base map — the areas they propose. We requested that participants specify up to ten areas, approximately "at the scale of the Level 2 Ecoregions," (which were shown on the bases map over which the polygons would be drawn) such that no more than 20% of the continent be covered. Each set of polygons was considered a data layer that captured the sub-group's priorities. Areas inside polygons were given a value of 1, while areas outside the region were given a value of 0.These maps were submitted to the server and the operator produced the overlay map which was, first, projected on the main screen so that all could see it, consider it, correct errors and comment on their own or other contributions. They were also invited at this time to add comments on the word processors.

The overlay map was then returned to each of the workstations and groups were asked to "change hats" and assume that they have been assigned the task of editing this map for final site designation. They then redrew polygons — with the same constraint on scale, number and total area — to produce what they envisioned as a final map.

The second iteration maps were resubmitted and the same overlay procedure was conducted. This procedure was repeated for each of the three questions and then a final overlay, showing all three sets of polygons, was produced and projected. This map was used for a discussion on priority areas for CEC action.

Participants were asked to comment on procedure for-

mally or informally during the meeting and, at the end, to complete a formal procedural evaluation. The results were intended to reveal both the extent to which technical or procedural barriers might have impeded (and hence distorted) group output and the degree to which participants thought that the process captured the "sense" of the group. Some of the results are discussed below.

The Experiences

From the standpoint of the CEC, the exercise was successful: it was possible to define priority areas based on the expert opinion attending the workshop. While this outcome might have been achievable without the Consensus Mapper format, the procedure ensured that each participant had the opportunity to discuss, reflect and contribute; it provided a record of the sequence of discussions leading to the nominated sites; and it provided a very clear perspective on areas of disagreement and barriers to precision in reaching consensus. The resultant priority areas are noted in Meredith et al. (2000) and include transboundary habitats such as, Baja to Bering, Yellowstone to Yukon, Yucatan to the Florida Keys and the Greater Gulf of Maine. There were several procedural lessons that emerged from the exercise. These are discussed below.

Decisions on Meeting Format and Participants

The procedure could be conducted over a web-based system with a very wide (essentially unlimited) list of participants. The Consensus Mapper Round Table format encourages dialogue and requires people to meet face-to-face. This limits possible participation and can thereby skew meeting outcome. Despite the expense of moving people, it was determined that a face-to-face meeting was required in this case because of the complexity of the issues involved, the differences in political settings, the differences in disciplinary and sectoral perspectives, and likely variation in selection criteria. Care had to be taken in building the participant base. We agreed to these criteria:

- national representation (ensuring that the three countries were effectively represented)
- sectoral representation (ensuring that government, ENGO and scientific interests were reflected)
- systematic representation (ensuring that expert views on conservation priorities for a broad array of taxa were included)

The outcome of the meeting is a partial function of these choices, and so in reporting results, the participation criteria and list must be included. In a community-based situation, if the results are to have credibility and wide acceptance, the selection of the criteria, participants and the format of the meeting must be itself a part of the process.

Advance Preparation

There are trade-offs associated with asking participants to prepare for the meeting in one way or another. At one extreme is the risk that no prior preparation will lead to too much of the limited meeting time being spent clarifying the goals and procedures, but at the other extreme is the risk that too much time spent in preparation will lead to marked differences in the preparedness of participants with the possibility that some might develop strategies to advance specific outcomes. In this case, we decided to create a web-based listserve that would connect all invited participants, make general requests for "recommended" datasets or information, and provide participants with the opportunity to make comments regarding the procedure or to distribute information. This did not work as well as we had hoped for two major reasons: first, electronic communication facilities are still far from seamless, so that some of what was posted was not available to everybody; second, people had different amounts of time, inclination and/or opportunity for accessing and reflecting on the information. We concluded that the degree of uniformity in preparedness would be inversely proportional to the complexity of the preparation material provided. The temptation to try to maximize productivity at a meeting by setting steep premeeting expectations can be counterproductive: material will need to be repeated meaning that some participants are bored while others are getting hasty (and perhaps unclear) summaries of essential preparatory material; some participants may have clearly defined prior strategies, while others may only be turning their attention to the issues of the meeting.

Data Availability

We distinguished two basic approaches to collaborative decision-making exercises: "information driven" (seeking individual response to a fixed information set) and "actor driven" (capturing opinions based on prior knowledge and/or access to distinct information sets of participants). This determines the approach taken to providing information during consultation. We adopted the latter approach and presented only orientation data (Level 2 Ecoregions Map of North America with overlays of political boundaries to state/province level, water bodies and watersheds, major roads and principal cities). Participants were asked to bring their personal expert knowledge to bear on prioritizing conservation areas for the CEC based on the CEC's unique continental mandate. This worked well (taking note of point one, above), but it was clear that those who had well-presented data (for example, published thematic maps) were much better able to influence the direction of discussion than were those with what might have been better scientific insight but less impressive documentation. Providing reference material does not overcome this bias unless long periods are available for

perusal. In this case, all the participants were professionals and were alert to the problems of data access and presentation; if a broader array of stakeholders were involved, these differences could be very significant and facilitators would have to try to minimize the resulting bias.

Flexibility of Agenda Vs. Product Delivery

A strict agenda, requiring lock-step movement through previously determined activities, can limit discussion and frustrate participants. On the other hand, very specific objectives require some degree of closure. In this case, we decided to begin with a clear, sequential, agenda but to be flexible enough to promote any particularly rich interchanges that evolved. This inevitably leads to awkward, on-the-fly judgments by a chair or facilitator and these judgments can influence the outcome of the process. For example, in plenary, questions arose about procedure. The intent was that within subgroups people could comment at will (so that all voices could be heard), but that heated dialogues (or monologues) that appeared not to hold the interest of the majority in plenary should be contained. What was lost by limiting these interventions cannot be known. However, in cases where productive and inclusive discussions in plenary indicated that rigid adherence to the proposed agenda would lead to a loss of information (or of goodwill), we did change the agenda. The ability to find and adopt alternative routes to the specified end-point is sometimes essential. Rigidity will alienate participants and undermine the principle of participation, but a lack of structure may simply lead to a progressive blurring of focus as the clock runs out (potentially a strategy for stakeholders whose interests are served by indecision).

Technology Support

We configured the room with six computer pairs: each was comprised of one networked GIS computer and one stand alone word processor. Participants were reminded at several points that the computer technology was not intended to drive the agenda but rather to serve as convenient and accessible tools for gathering information. However, we did want people to leave a "paper trail" of map evolution and comments. There is a learning curve for any procedure, and a cost in time required for people to break the conventional pattern of discussion and make notes on a computer. We began with one support person per group. The support person performed three tasks: one was to ensure that all the equipment worked and that its use was easy for participants; the second was to encourage or remind people that salient ideas should be recorded; the final was to watch the clock and attempt to ensure that maps and comments were available for the plenary. The importance of the support person diminished as participants acclimatized to the procedure. It was clear that a heavy investment in support at the beginning yielded benefits that enriched the entire process. This was a key element in making the technological aspect of the workshop successful.

Mapping, Precision and Accuracy

As noted, questions arose with respect to recording responses: should respondents give a binary response (priority=1, non-priority=0), an ordinal response (high=3, mid=2 ... etc.), or a ranked response (10 = most, 9=next ... etc.)? The approach taken affects both the mechanics of the meeting, and the clarity and precision of the result. We selected a simple binary system and placed an arbitrary upper limit on total number of sites and total area to be selected. Some of the participants felt that this limited the accuracy of the results they could give, although all recognized that some steps need to be taken to harmonize inputs from the different groups. At the stage of the merging maps in plenary sessions, the question of precision arose: areas of overlap were recognized as accurately reflecting core areas of concern, but any attempt to make boundaries precise led to disagreements that often reverted to the underlying assumptions (e.g. should areas be homogeneous or eclectic, should boundaries be administrative or natural). Any precise lines would have been somewhat arbitrary and controversial, general areas lacked precision but accurately reflected the group position. Depending on goals, the relative ease of getting accuracy probably makes it a more efficient objective than precision.

Opinion Leaders

It was our intent to monitor each of the above issues. Two "lessons" emerged spontaneously from the event. The first was the extent to which the success of the workshop depended on the goodwill of the participants which, in turn, depended in part of the signals from opinion leaders within the group. The rigors of a full agenda, a novel and somewhat complex procedure, and an overall goal to which not all participants necessarily subscribed fully could derail a procedure. If this is confounded with any physical discomfort (meeting rooms that are less than comfortable, missed meals, residual effects of travel) the potential for a lost meeting is increased. It was evident at this meeting that "participating in the spirit of the invitation" (i.e. agreeing to work hard over two full days to cover a lot of material and reach an end-point that would meet the needs of the organizer) was partly dependent on a small group of participants who remained very "upbeat" even when other participants voiced frustration. While it was not done at this meeting, organizers might consider prior requests to some participants to "lead from within" if potentially crippling attitude shifts appear to be emerging.

Follow-Up

The most surprising procedural finding was the follow-up e-mail exchange. As noted in point 2, above, it was difficult to get busy people to invest preparatory time in a meeting whose significance they might not have grasped or supported fully. In light of that, our intention was to be sure to terminate the process at the actual meeting; that is, we would not make the outcome of the meeting contingent on anything that participants had to do after the meeting ended (like sending in summary sheets). Nonetheless, we agreed to post preliminary results by e-mail. The draft press release and the accompanying draft map produced almost two months of intense, analytic and constructive e-mail. Although, of course, participants were self-selecting, the amount of thought and reason that went into the follow-up e-mail suggested that once people have subscribed to a process and an objective, despite being busy, they are willing and able to continue to contribute. This may not be easy or even possible to orchestrate in any given case, but the possibility of "run-on" benefits should not be foreclosed. It may be that the period of reflection after the meeting, and the requirement of ordering thoughts that written e-mail imposes, create conditions for some of the most insightful contributions.

Next Steps

One goal of CBED is to have a simple computer-based spatial decision support system that can be deployed quickly and reliably in any community where collaborative EDM is necessary. The opportunity to work in a situation where trinational experts were meeting over a limited time period with agreed objectives allowed us to experiment with almost a SWAT team approach to Consensus Mapper. The experience of using high-technology tools to get "community" involvement is in marked contrast to the example in the next paper. But the lessons learned are valuable and will help make the application of the tool in less well-structured circumstances much more effective. A solution, for example, might be to invite stakeholders who are engaged in a complex real-world situation where conflicts are deep rooted and rates of progress are expected to be slow, to treat participation in a short term Consensus Mapper exercise as a "game" designed to clarify issues and pinpoint areas for further research. Under those circumstances, stakeholders may be willing to commit, in good faith, to an exercise that would build understanding and perhaps an agenda for further action. Under such circumstances, the cost of procedural failure of the workshop would be high. By drawing on the lessons learned in the CEC exercise, the probability of succeeding with the workshop is higher.

References

Craig, W. J., T. Harris and D. Weiner (eds.). In Press. *Empowerment, Marginalization and Public Participation: Report of Specialists Meeting*. NCGIA, UCSB, Santa Barbara. London: Taylor & Francis.

Meredith, T.C., George Dias, Camellia Ibrahim, Robert Tipple and Tara Wilkinson. 2000. *Reaching Consensus on Biodiversity Conservation Priority Regions: A Report on the Commission for Environmental Cooperation Strategic Directions for the Conservation of Biodiversity*. Montreal: The Commission for Environmental Cooperation.